

LOW NESTING SUCCESS OF LOGGERHEAD SHRIKES IN AN AGRICULTURAL LANDSCAPE

JEFFERY W. WALK,^{1,2,4} ERIC L. KERSHNER,^{1,3} AND RICHARD E. WARNER¹

ABSTRACT.—Southeastern Illinois is dominated by cropland, and the remaining pastures or grasslands are marginally suitable for breeding Loggerhead Shrikes (*Lanius ludovicianus*), owing, in part, to limited nest sites. From 1998 through 2000, we recorded poor nest success (26%) among shrikes, although results of earlier studies (1967–1972) in this region indicated that nest success was 72 to 80%. Clutch size (5.7 eggs) and fledglings/successful nest (4.4 young/successful nest) were similar to those reported in previous studies. During our study, generalist mammalian predators were abundant, and most nest failures (88%) were caused by predation. We suggest that the loss of grassland habitat and agricultural intensification has resulted in reduced nest success, and this may be true in other areas of the species' range as well. Received 20 August 2003, accepted 23 November 2005.

The Loggerhead Shrike (*Lanius ludovicianus*) is of conservation interest throughout its range, and has been designated a "Bird of Conservation Concern" (U.S. Fish and Wildlife Service 2002). The range of the species has contracted greatly over the past half-century (Cade and Woods 1997), and Christmas Bird Count and Breeding Bird Survey data indicate a continent-wide decrease in abundance. The sharpest declines have occurred in the core of the shrike's range in southern and Gulf Coast areas (Yosef 1996).

Most studies of Loggerhead Shrikes have revealed high nest success (mean of 56%; Yosef 1996, Esely and Bollinger 2001), suggesting that problems associated with winter habitat and survival may be causes for population declines (Haas and Sloane 1989, Brooks and Temple 1990, Gawlik and Bildstein 1993). Based on reports of high nest success throughout the species' range, Maddox and Robinson (2004) considered it fortuitous that habitat degradation had not resulted in elevated rates of nest predation or decreased productivity. Our observations, and the results of some, more recent studies (DeGeus 1990, Yosef 1994, Collins 1996, Esely and Bollinger

2001), suggest there are landscapes and nest-site contexts in which this presumption does not apply. Our objectives were to measure nest success of Loggerhead Shrikes in a region of intensive agriculture with marginal habitat, and to determine whether land use near nests, or nest-site context, influenced nest fate.

METHODS

From 1998 through 2000, we monitored Loggerhead Shrike nests within a 125-km² area of southern Jasper County, Illinois. The study was centered on Prairie Ridge State Natural Area (88° 12' W, 38° 57' N) and included most of Smallwood Township and adjacent portions of Wade and Fox townships. Jasper County's landscape is composed of 71% row crop (corn, *Zea mays*; and soybeans, *Glycine max*), 6% wheat (*Triticum aestivum*; most double-cropped to soybeans after harvest), 6% rural grassland (hay, pasture, roadsides, and idle grass), 13% woodland, and 1% roads, residential/urban areas, and small amounts of open water and other land covers (Illinois Interagency Landscape Classification Project 2002). Our study area differed from the county as a whole by having greater row crop cover (>85%) and less woodland cover (<5%; JWW unpubl. data).

Between 1966 and 2000, North American Breeding Bird Survey results suggested declining abundance of Loggerhead Shrikes in Illinois (−4.5%/year) and the Midwest (−0.3%/year in the eight states of U.S. Fish and Wildlife Service Region 3; Sauer et al. 2005). From 1994 to 1996, roadside searches

¹ Dept. of Natural Resources and Environmental Sciences, Univ. of Illinois, Urbana, IL 61801, USA.

² Current address: Illinois Natural History Survey, One Natural Resources Way, Springfield, IL 62702, USA.

³ Current address: Inst. for Wildlife Studies, 2515 Camino del Rio South, Ste. 339, San Diego, CA 92108, USA.

⁴ Corresponding author; e-mail: jwalk@dnrmail.state.il.us

within 49 km² of the center of our 1998–2000 study area documented 12 (1996) to 16 (1994) shrike territories annually (roughly 0.25–0.33 shrike territories/km²; JWW unpubl. data, reported to the Illinois Department of Natural Resource's Natural Heritage database). During our 1998–2000 study, the densities of nesting shrikes were similar to, or lower than, that reported during the 1994 to 1996 roadside surveys.

From March through June, we located shrike nests by locating adults or food caches, searching nearby suitable nest sites, observing nest building, or observing provisioning of incubating females and nestlings. Because the study area was almost entirely private land, initial searches were limited to roadsides. When shrikes were located, we often were permitted to search for, and monitor, nests on private land. We checked nests every 3–5 days until their fate was determined, and we calculated nest and egg success based on exposure days (Mayfield 1975, Johnson 1979). When nests failed, we assumed failure occurred at the midpoint between nest checks.

We recorded nest context and visually estimated the percentage of land-use types within 100 m (3.1 ha) of nest sites (after Gawlik and Bildstein 1993). Land-use categories were (1) row crop; (2) hay or pasture; (3) idle grassland; (4) woody vegetation (forest and shrub areas combined); (5) small grains; (6) roadways, including grassy rights-of-way; and (7) residential (yards and farmsteads). We compared measurements at nest sites with 20 random locations, each also 100 m in radius and selected by overlaying a map of the study area with a numbered grid. Because shrike nest sites are limited to woody vegetation, we centered random locations on the tree or shrub closest to each randomly selected point. We characterized the context of nest sites and random trees as follows: fencerows, farmsteads/yards, watercourses, woodland edges, or isolated trees (>20 m from another tree). Because the proportions of land uses were not normally distributed across the study area, we used Mann-Whitney *U*-tests to compare land use between random sites and nest sites, and between successful and depredated nests. Contexts of nest trees and random trees, and trees with successful and depredated nests, were compared using a chi-square test. Unless

otherwise noted, values are reported as means $\pm$ SE.

RESULTS

We monitored 34 shrike nests from 1998 through 2000. Ten nests (29%) fledged ≥ 1 young, 21 nests (62%) were depredated, 2 (6%) were abandoned during egg laying, and 1 (3%) was dislodged from a tree during a thunderstorm. Nest failures attributed to predation included 6 empty nests with no evidence of the predator, 4 tilted or compressed nests, and 11 highly disturbed nests (lining removed, nest shredded, or completely dislodged). At one depredated nest on a farmstead, the cooperators reported to us that their domestic cat (*Felis catus*) had killed one of the adults. Shrike nests appeared to be more vulnerable to predation near hatching. Of 22 nests surviving to at least the 14th day of incubation, 8 were eventually lost to predators before the nestlings were 4 days old.

From the beginning of egg laying to fledging, egg success was 20.5% and nest success was 25.6% (95% CI = 19.4–33.8%). Clutch size was 5.7 ± 0.2 eggs ($n = 30$ nests). In nests that survived until at least the second nest check after hatching, $87.5 \pm 3.6\%$ of eggs hatched successfully ($n = 10$ nests). Although 4.4 ± 0.4 young fledged per successful nest, only 1.3 ± 0.4 young fledged per nest attempt.

Land use within 100 m of shrike nests included more hay and pasture than randomly located points (Mann-Whitney $U = 241.0$; $P = 0.049$), but no other variable that we measured differed between nest and random locations (Table 1). Land use did not differ significantly between successful and depredated nest sites. The majority of the nests we monitored (87%) were located in small (<3 ha) pastures (including the enclosing fences) or yards/farmsteads, and were within 50 m of county roads. Although shrike nests were placed in fencerows more frequently than expected ($\chi^2 = 25.69$, $df = 4$, $P < 0.001$), nests in fencerows were more likely to be depredated ($\chi^2 = 10.94$, $df = 3$, $P = 0.012$; Table 2). Daily nest survival was 0.957 ± 0.012 in fencerows and 0.973 ± 0.013 in yards/farmsteads.

TABLE 1. Percent land use ($\pm$ SE) within 100 m (3.1 ha) of random trees and Loggerhead Shrike nest locations in Jasper County, Illinois, 1998–2000.

Land use	Random sites (n = 20)	Nest sites		
		All (n = 33)	Successful (n = 10)	Depredated (n = 21)
Row crops	58.6 $\pm$ 6.9	51.0 $\pm$ 4.9	51.3 $\pm$ 9.2	54.4 $\pm$ 6.1
Hay and pasture	7.5 $\pm$ 4.7	19.4 $\pm$ 4.9 ^a	18.5 $\pm$ 9.5	19.3 $\pm$ 5.9
Idle grassland	10.5 $\pm$ 6.0	5.9 $\pm$ 2.6	6.0 $\pm$ 5.1	6.4 $\pm$ 3.5
Woodland	7.2 $\pm$ 2.9	2.6 $\pm$ 0.9	3.0 $\pm$ 1.9	1.8 $\pm$ 0.5
Small grains	2.8 $\pm$ 1.6	3.2 $\pm$ 1.6	0.0 $\pm$ 0.0	2.9 $\pm$ 2.0
Roadway	5.8 $\pm$ 1.4	9.5 $\pm$ 1.3	7.5 $\pm$ 2.0	10.2 $\pm$ 1.8
Farmstead, yard	7.3 $\pm$ 2.2	8.8 $\pm$ 2.4	13.0 $\pm$ 5.4	7.6 $\pm$ 2.8

^a Significantly more hay and pasture at nest sites than random sites (Mann-Whitney $U = 241.0$, $P = 0.049$). There were no other significant (all $P > 0.08$) differences in land use between random and nest sites or between successful and depredated nests.

DISCUSSION

Reproductive success of Loggerhead Shrikes in this agricultural landscape (25.6% nest success, 20.5% egg success) is among the lowest reported for the species. Graber et al. (1973) reported 80% nest success in southeastern Illinois in 1967 and, in Jasper and nearby counties, Anderson and Duzan (1978) observed 72% nest success in 1971–1972. By 1991–1992, Collins (1996) found that the proportion of fledglings to number of eggs laid had dropped to 25% in southern Illinois. Our methods for measuring nest success (Mayfield 1975) differ from that used by Collins (1996), but the results are similar and suggest a substantial reduction in shrike nesting success in the region.

Clutch size (5.7 eggs) in our study was similar to those of recent Midwestern studies (5.3–5.7 eggs; Burton 1990, DeGeus 1990, Collins 1996, Esely and Bollinger 2001). Our measure of 4.4 fledglings per successful nest

was the same as the mean reported from 14 studies compiled by Esely and Bollinger (2001). Toxicological problems affecting egg viability are not implicated; an analysis of organochlorine residues in shrike eggs, including several eggs collected in our study area in 1995 and 1996, indicated that DDE levels had decreased 79% in the region since the early 1970s (Anderson and Duzan 1978, Herkert 2004). Roughly 88% of fully incubated eggs hatched successfully during our study.

Intensified agricultural land use and a concomitant increase in the abundance of generalist predators are likely the causes for a decrease in shrike nesting success in this landscape. Predation was implicated in 88% of the nest failures and in 62% of all nesting attempts in our study. From 1970 to 2000, acreage of row crops increased by 26% in Jasper County, while hay acreage decreased by 85% and pasture decreased by about 47% (Illinois Department of Agriculture 1971, National Agricultural Statistics Service undated). Potential nest sites in this landscape are few and most occur in linear habitats, often limiting shrikes and other birds to nesting situations in prey-rich corridors that are easily searched by predators (Major et al. 1999). Furthermore, human structures and agricultural waste may subsidize populations of generalist predators (Warner 1985, Dijk and Thompson 2000). Road-kill surveys conducted by the Illinois Department of Natural Resources from 1975 through 1998 documented increases in the abundance of raccoons (*Procyon lotor*) and opossums (*Didelphis virginiana*) of more than 250% and 100%, respectively (Gehrt et al. 2002; S. D. Gehrt pers. comm.).

TABLE 2. Proportions of Loggerhead Shrike nests and random tree locations within various land-use contexts in southeastern Illinois, 1998–2000.

Context	Random sites (n = 20)	Nest sites		
		All (n = 34)	Successful (n = 10)	Depredated (n = 21)
Yard, farmstead	0.35	0.24	0.40	0.14
Fencerow	0.20	0.53 ^a	0.30	0.62 ^a
Watercourse	0.15	0.15	0.20	0.14
Woodland edge	0.15	0.00	0.00	0.00
Isolated tree	0.15	0.09	0.10	0.10

^a Loggerhead Shrike nests were placed in fencerows more frequently than expected ($\chi^2 = 25.69$, $df = 4$, $P < 0.001$), and nests in fencerows were more likely to be depredated ($\chi^2 = 10.94$, $df = 3$, $P = 0.012$).

Successful shrike nests were more likely to be in yards, whereas depredated nests were more likely to be in fencerows. Yards are not benign breeding habitat, however. Gawlik and Bildstein (1990) recognized the potential threat of predation by domestic cats on adult shrikes and their young, and during our study, a cat killed at least one yard-nesting adult shrike. Row crops were the most common land use near nests, reflecting the ubiquitousness of cropland in the landscape, but shrikes preferentially selected nest sites in or near pastures (Table 1). Most pastures in our study area were small (<3 ha) horse pastures adjacent to residences, which were located primarily along county roads. Shrikes elsewhere also frequently nest near roadsides, and the shorter grasses and utility lines along roadsides may be superior hunting areas (Luukkonen 1987, DeGeus 1990, Gawlik and Bildstein 1990, Smith and Kruse 1992). The visibility of shrikes on utility lines (i.e., along roads) may have contributed to high representation of pasture habitat near the shrike nests that we monitored, but little suitable nesting habitat was available to Loggerhead Shrikes away from roadways in our study area. Although widely used, roadways and other linear habitats may be ecological sinks for nesting shrikes, given the low nesting success we found and that has been reported elsewhere. Yosef (1994) found lower nest success among shrikes nesting in fencerows (36%) than for those nesting within pastures (54%) in Florida. Likewise, roadside-nesting Loggerhead Shrikes had 39% nest success in Missouri (compared with 76% success for interior nests; Esely and Bollinger 2001), 35% nest success in Iowa (DeGeus 1990), and 31% egg success in Indiana (Burton 1990).

Pasture and hay acreage has declined by 50% in the Midwest over the past 50 years (Herkert et al. 1996). At the same time, shrikes have declined or disappeared from much of the region (Cade and Woods 1997, Sauer et al. 2005). Our results—documenting a sharp decrease in nesting success in a county with recent land-use changes typical of the Midwest—suggest that nesting success, often thought to be relatively high for shrikes (Yosef 1996, Maddox and Robinson 2004), will need to be re-evaluated as land-use changes

result in a less optimal environment for Loggerhead Shrikes.

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